

The Question of Acid and Alkali Forming Foods*

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FADDISTS rampant in the realm of pseudo-science have seized upon the acid base balance of the body as an apt subject for their sophistry. As a consequence, much more is written and said on this topic than is warranted by known facts, and much that is so blandly asserted, especially for lay consumption, is distorted and incoherent.

The acid base balance is a condition in which the ratio of carbonic acid to bicarbonate in the blood is maintained in a definite state of equilibrium. Although alterations in the hydrogen ion concentration of the blood and body fluids may and do occur within certain narrow limits, such changes are due to serious disturbances of metabolism or in the functioning of body organs, usually the result of severe morbid conditions. The effects of foods on this acid base balance have been greatly exaggerated, for their influence in bringing about modifications in the chemical content of the blood is practically nil.

All foods may, of course, be classified chemically as acid forming, base forming, or potentially neutral. By calculating the equivalent in normal acid present in the form of chlorine, phosphorus, and sulphur; and the

normal alkali in terms of the calcium, magnesium, potassium, and sodium in particular foods; relative values of excess potential acid or base can be expressed.

Such calculations reveal that foods of decided potential acidity include meats of all kinds, fish, shellfish, and eggs, while cereals and breadstuffs show a mild acidity. The base forming foods include most of the fruits and vegetables, with milk and cream displaying a slight potential alkalinity. The citrus fruits contain acid radicles, but these are burned in the body so that the end products are potentially alkaline. Pure fats, sugars, starches, and other foods devoid of minerals are neutral in their reactions.¹

In the ordinary mixed diet which is the customary fare of the individual who has not succumbed to the wiles of a food fakir, the acid and base forming elements in the diet will be reasonably well balanced. According to some authorities, however, a slight preponderance of alkaline foods is desirable, possibly for the reason that normal blood is mildly alkaline, with a hydrogen ion concentration (pH) averaging 7.35.

The scientific basis for such a categorical recommendation seems, nevertheless, to be somewhat tenuous. Recent investigations reported by Bischoff *et al.*, have shown that there is no

* Read before the Food and Nutrition Section of the American Public Health Association at the Sixty-fifth Annual Meeting in New Orleans, La., October 21, 1936.

significant difference in the acid base picture of the blood of normal individuals when they are fed mixed diets containing excessively acid or excessively alkali producing foodstuffs.² The ingestion of a quart of milk, a quart of orange juice, or a pound of bananas, all alkali forming foods, produced not even a temporary shift in the hydrogen ion concentration of the blood plasma, or in the alkali reserve. A pound of steak, giving an excessively acid ash, caused no changes in 3 out of 4 subjects, although there was a slight temporary reduction in plasma bicarbonate in one instance.

These interesting experiments, as well as others, indicate that the daily administration of 45 gm. of sodium bicarbonate is necessary in order to raise the pH of the blood by even 0.2 and that 15 to 20 gm. of ammonium chloride are required to lower the pH of the blood by a similar amount. In order to accomplish the same results by means of food, 18 lb. of oranges would be required in the diet at one time to bring about a shift of the blood toward greater alkalinity, and 4½ lb. of lean beef, or 2 lb. of oysters, the most acid of all foods, would be necessary to produce an effect comparable to that caused by the ingestion of 15 gm. of ammonium chloride.

It is obvious, therefore, that foods consumed in the usual quantities will not alter the acid base balance of the normal person. The explanation for this phenomenon lies in the fact that the human machine is a compensatory mechanism that remains remarkably stable under different conditions. This steady state, called "homeostasis" by Cannon,³ is maintained by means of various delicate defense mechanisms of the body.

The first and foremost of these defense mechanisms is the buffer action of the blood itself. The important proteins of the blood, hemoglobin and

oxyhemoglobin, together with the blood chloride and alkaline phosphates and bicarbonate, react with the carbonic acid of the blood to establish a more or less constant equilibrium. This balance is further aided by the lungs as they dispose of carbon dioxide, the decomposition product of carbonic acid. The lung is consequently the second defense mechanism in the control of the acid base balance.⁴

The third of these body defense mechanisms is the kidney, which unlike the blood, may show a relatively wide range of acidity and alkalinity, varying in extreme instances from pH 5 to pH 8. Excessive quantities of fixed acid or alkali are eliminated through the urine, but this fine adjustment may fail in the presence of certain diseases of the kidney, so that acidosis or alkalosis may occur.

True acidosis is a symptom rather than a disease. The word is, however, a favorite one with food charlatans, who prate of the dire results from certain food combinations. Acidosis is also a popular term with the more gullible of the laity, who invariably confuse this condition with gastric hyperacidity, or so-called "acid stomach," which is due to an excess of hydrochloric acid in that much abused organ.

The accumulation in the body of an excess of acid, or the loss from the body of alkali, occurs as a rule only in certain severe ailments in which there are disturbances of metabolic processes or organic derangements. In addition to nephritis and other kidney troubles, acidosis may accompany diabetes or the diabetic coma, severe diarrhea, starvation, and acute infections, such as pneumonia and sepsis. Acidosis is apparently more common in young infants than in adults, especially in connection with infantile diarrhea, vomiting, and dehydration but, according to Paterson, acidosis or ketosis by itself

leads to little or no change in the clinical picture of the sufferer.⁵

In many clinical reports, the term "ketosis" is used interchangeably with acidosis. Although acidosis may be associated with a ketogenic, or high fat, low carbohydrate diet, ketosis itself is a condition in which there is an accumulation of ketone bodies in the blood as the result of an incomplete combustion or aberrant oxidation of the fatty acids provided by the diet. This condition, usually expressed in terms of the acetone present, is not in itself acidosis. The ketogenic diet is now used in the treatment of epilepsy, migraine, and certain other maladies.

The scientific evidence indicates, therefore, that the question of acid and alkali forming foods is a negligible problem in human dietetics. "It is still an open question," wrote Sherman (in 1932), "whether the acid base balance of the mineral elements of the diet is or is not of practical significance in human nutrition."⁶ Evidence showing the relative unimportance of the effects of acid ash and alkaline ash foods has been ably summarized in the Report of the Committee on Nutritional Problems of the American Public Health Association for 1935-1936.⁷

Despite this evidence, food fakirs continue to exploit the alleged dangers of acid foods, and rant over the chimerical hazards of incompatibility in foods. One widely publicized system of diet is based on the erroneous theory that proteins and starches, and fruits and starches should not be mixed in any one meal. As a reason for this perverted idea, it is declared that protein digestion takes place in the acid contents of the stomach, while starch can be digested only in the alkaline intestine, and that carbohydrates encounter some sort of baleful interference when associated with protein in the stomach.

The fallacy of this weird notion will be readily apparent to anyone possessing even a rudimentary knowledge of physiology, but the fallacy has also been exposed in a number of recent scientific experiments. Thus, Rehffuss has shown from gastric analyses of 50 individuals that there is no incompatibility between proteins and carbohydrates in the stomach,⁸ and Shay *et al.*, have recently reported, from gastric secretory studies on 5 subjects, that mixtures of protein and carbohydrate not only do not interfere with gastric secretion, but that carbohydrate digestion in the stomach is actually prolonged and encouraged by its mixture with protein.⁹

As pointed out by Rose,¹⁰ an avid public gloats in a belief in magic as applied to human nutrition. Food fads fostered by quacks and ignoramuses, some of whom can claim "M.D." degrees, are espoused and religiously followed by a host of deluded persons. It is the duty of public health officials, as the logical educators of the public in sensible hygiene, to aid in debunking fads and follies, such as the belief that acidosis results from acid foods, and that foods of different chemical compositions can upset the acid base balance of any normal person.

SUMMARY

Although foods may be classed as (1) acid forming, (2) alkali forming, or (3) potentially neutral, there is no scientific evidence to indicate that any one food or combination of foods can significantly alter the acid base balance in a normal individual.

Acidosis is a symptom in certain morbid conditions, but the nature of the diet plays no appreciable part in the development of acidosis, despite the fallacious arguments of food charlatans who exploit unscientific systems of dietetics predicated on excessive acid

forming foods, or on the incompatibility of various food elements.

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Upper Potomac River District

... Provisions were made by the 1935 General Assembly for the creation of the Upper Potomac River Commission for the purpose of conserving, regulating, and controlling water resources within the Upper Potomac River District, as discussed in the 1934 report. The act defines the boundaries of the district and delegates to the Commission certain powers and privileges, and provides for the government of the District by the Commission.

The Commission is authorized to acquire by purchase or condemnation lands, structures, or buildings, or any stream bed, water way, road way, rights of way, watershed or water rights within the District, for the construction, expansion, or maintenance of any dam, reservoir, or appurtenances thereof; to provide for the construction, maintenance, and operation of structures, buildings, dams, impounding reservoirs, and appurtenances; to provide for the regulation of the flow of water within the district and its tributaries; to provide for the levy of taxes by the County Commissioners of Allegany County for the operation, maintenance, regulation, and control of works purchased, acquired, or constructed under the provisions of this Act; to authorize the County Commissioners of Allegany County to submit to the voters of said County the advisability of making a capital expenditure of not exceeding \$200,-

000 in furthering the purposes of this Act, and, in case of a favorable vote thereon, to borrow or sell bonds up to that amount and turn the proceeds thereof over to the Upper Potomac River Commission; to secure benefits of an Act of the Congress of the United States of America approved June 16, 1933, known as the National Industrial Recovery Act, and any Acts amendatory thereof, and any Acts supplemental thereto and revisions thereof, and any further Act or Acts of the Congress of the United States of America to encourage public works, to reduce unemployment and thereby to assist in the National Recovery and to promote the public welfare, or to regulate the flow of navigable or other streams, to conserve water resources and to provide for the penalties for violation of the provisions of this Act.

The Commission is composed of 3 members; 1 appointed by the County Commissioners of Garrett County, and 1 by the County Commissioners of Allegany County, and the 3rd named by the Governor.

The territory included within Allegany County and Election District No. 4 of Garrett County constitutes the Upper Potomac River District for the purposes of the Act.—*Annual Report of the Bureau of Sanitary Engineering of the Maryland State Board of Health—Year 1935.*